

that *part* of their producing gas may be even far outside the usually considered limits of everything belonging to the earth.

M. Thollon, indeed, gives a view of the "B" region, "as," he says, "it would appear if observed outside the earth's atmosphere"; and therein he shows every line constituting our magnificent earthly constellation "Great B," absolutely wiped out of existence—a few *ultra*-faint, accidentally intruding solar metallic lines alone excepted. But how has the eminent *savant* obtained that view? Not by ascending in a balloon, or up the sides of a high mountain above all the grosser atmosphere, and seeing that it was so, but merely by observing some small amount of difference of effect, at two slightly different degrees of large zenith distance, viz. 60° and 80°, at the Observatory of Nice.

Two points, however, alone, will never enable a curve to be drawn on their sole authority; and as a curve of effect is what the investigation now requires, M. Thollon's hitherto merely duplex observations will acquire a far greater power of conviction for other men's minds, if he will kindly supplement them with others at 20° Z.D., or as near to it as the latitude of Nice will allow him at time of summer solstice. Still more would he make us all his debtors if he would repeat those three angular directions at three successive stations at greater hypsometric altitudes; duly remembering that while every one knows that water-vapour and oxygen (the gaseous parentage of "B" according to the grand experiments of M. Egoroff) do exist in the earth's atmosphere, that does not, by itself, therefore render them impossible in greater or less quantity to the outer region of the sun's envelopes; or, in a highly attenuated degree, to the 92,000,000 of miles of space between. C. PIAZZI-SMYTH

15, Royal Terrace, Edinburgh, September 27

Shifting of the Earth's Axis

WITH reference to the letter of Mr. W. M. Flinders Petrie (*NATURE*, September 25, p. 512), I would remark that there has been no sensible change in the latitude of Greenwich (as found by observations of circumpolar stars) during the last forty-seven years, a period nearly twice as long as that covered by the Pulkowa observations which M. Nyrén has discussed. In a paper on the "Systematic Errors of the Greenwich North Polar Distances" (*Mem. R.A.S.* vol. xlv.), I have exhibited the results for the co-latitude of the centre of the Greenwich transit-circle for each year and for groups of years from 1836 to 1877 reduced to the same refractions throughout (Bessel's), and corrected where necessary for index-error of the thermometer, and the accordance of the individual results is as close as can be expected, when allowance is made for the systematic errors to which all observations are liable, but which are usually ignored in estimating theoretically the probable errors of mean results. It may suffice if I here give the results for co-latitude for three periods of years:—

1836-49	mean co-latitude	38° 31' 21"·85
1851-65		21"·87
1866-83		21"·85

The first and last results are identical and are absolutely inconsistent with Mr. Petrie's supposed increase of the Greenwich co-latitude of 1" or more in a century.

W. H. M. CHRISTIE

Royal Observatory, Greenwich, S.E., September 27

The Sky-Glows

FROM the great purity of the sky this evening, and from the flatness of the horizon westwards, on the line of the Great Northern Railway between Huntingdon and Hitchin, the sunset glow was of a very beautiful description. At five minutes before six (watch-time, three or four minutes slow) the sun set; and it was no sooner hidden than a parhelion-like patch of white light, 6° or 8° in diameter, brighter than the rest of the sky, occupied a place 10° or 15° above the sunset point of the horizon, and continued shining there with pearly brightness for about ten minutes. The horizon-line became edged at the same time with bright red, melting abruptly away upwards into orange, and higher up into a field of yellow light round the lucid spot. At 6.5 this spot's white light began to acquire a rosy tinge, and during the next ten minutes, until 6.15, it became intensely rose-coloured, preserving its definite place unchanged in the upper expanse of yellow; a vivid golden oriole-yellow stripe some degrees broad divided it from the red fringe along the horizon, the dazzling gold colour shading exquisitely into the fiery red

below and rosy red above, and deriving itself from the latter a bronze-like greenish cast in its bright golden hue by contrast.

By 6.15 the rosiness of the bright spot had extended upwards and outwards from its centre, and was now blended in its colour and confines with the yellow band and red fringe below it, until the whole presented a conflagration or red aurora-like outburst of light in the west, 20° or 25° high, and extending 45° or 50° in base along the horizon.

The yellow belt was fading out of this glory, and the brightness and rosiness of its upper part was fast disappearing, when at 6.15 there appeared, with extreme quickness in the brighter base, dark intervals dividing it into upward radiating diverging beams of light, which rapidly acquired such fixed breadths and distinctness that I easily counted six or eight separate beams nearly equidistant from each other, and of equal lengths and strengths, marking out plainly by their divergence the sun's place, and the considerable depth to which it had already sunk below the horizon. The two outer ones only of the beams, on the northern side, were a little confused together, and marred the symmetry which the whole presented, but the full number of their display was several times counted over during the ten minutes—until 6.25—that they continued visible. They were about 15° long from their bases, and extended across and usurped to themselves the light of what had been the golden-yellow belt; but they gradually shortened and became dull red when at the latter hour the horizon assumed the red appearance which it usually presents some time after sunset. The above striking phases of the glow,—the white spot, the rose-red one, and the streamers,—occupied just ten minutes each, and the unusual aspect of the sky ceased entirely just thirty minutes after sunset.

The patch of whitish light observed this evening had all the appearance of a true, but extended and diffused, mock sun of some description; and I have noticed the peculiarity before, in the sunset glows of last winter and spring, whenever I had an opportunity to see the sky and watch their early phase just after sunset; but crystals of ice being then plentiful in cirrus, the evidence of the mock sun's formation by non-aqueous dust in the atmosphere was not so strong as now, when it has recurred after a long continuance of a summer temperature which has been unusually high. It is also singular and curious that the rosy tint began in the white-glow spot, and spread evenly outwards from it as a centre, as the extent and intensity of this remarkable colour grew and increased.

Appearing as the white spot does, when I have seen it, at a pretty fixed height of not less than about 12° from the horizon as soon as the sun has set, it seems difficult to reconcile its presence at such an altitude with a theory of its production by reflection of the sun's horizontal rays from fine films or laminae of floating glassy dust, unless descending equatorial currents, perhaps, in those extremely stable heights may have a sensible inclination downwards from the west, and may tilt the films' under sides in a direction corresponding with that of the current slightly towards the sun?

With regard to the diverging beams, they are also, perhaps, not quite ordinary, irregularly produced straight lines of radiation; but seemed by their symmetry to be connected, at least in the origin of the shadow-gaps which formed them, with evenly ruled stripes or pleats of the cirrus, and of loftier haze, in this case directed, it seemed, nearly east and west. With such haze-bands and stripes directed rather more sou h-westerly, or about towards the point of winter sunset, and intersected also with slightly slanting systems of striation, I constantly noticed the sky in Newcastle-on-Tyne, during the prevalence last winter and spring of the repeated sunset glows, to be for weeks and months more or less constantly and uniformly, but in general weakly and dimly, streaked and furrowed over. Either an unusually steady current was prevailing in the upper air; or else a permanent current there, and long lines of aerial disturbances troubling its streams were made more visible and conspicuous than ordinary, by exceptional radiation, or some other unusual refrigerating and haze-engendering cause, depriving the upper air of its transparency, during the time of the sky's presenting such unusual appearances in what Quetelet named and considered to be the "stable" or untempestuous upper regions of the atmosphere.

Whatever may be the explanation of the streamers and of the white glare-spot, observations may perhaps be made of them under even more favourable conditions than occurred this evening, and they would then possibly give a little help towards arriving at some further conclusions both as regards the crystalline or other nature of the haze-causing substance, and as to the

manner and direction of the motions of the extremely lofty air-currents in which the finely-divided material is suspended.

A. S. HERSCHEL

Collingwood, Hawkhurst, September 20

ON September 27, being on the river about 6 p.m., I noticed the beautiful colour of the sky, which lasted for three-quarters of an hour after sunset. The day had been very cloudy, but not much rain had fallen, and about 4.30 p.m. the sky cleared and the sun shone out. My attention was drawn to the appearance of the sky about 6.15, after the sun had set. Great masses of red appeared in the west on a background of gold and primrose; above this the sky shaded from green into blue; the red colour extended upwards for about 40°, and appeared of various shades, deep red, magenta, and rose colour, the various small clouds which were floating about being pink. This red light gradually broadened out and died away, giving place to deep orange and gold, the latter colour lasting till 6.45.

The water was as gorgeous as the sky above, the reflections of the trees being bright red and purple on a floor of gold. I may add that the red light from the sky was so strong that a rosy hue was thrown on some trees and everything around.

Hurley Mill, September 28

T. M. BROWNE

September Stream of Krakatoa Smoke at Strong's Island

AFTER long delay, owing to the wrecking at Strong's Island of the *Morning Star*, I feel very fortunate in coming into possession at last of a most important record of fact, which I hasten to publish, in the form of an extract from the journal of Miss Cathcart, the young lady missionary labouring at Strong's Island with Rev. Dr. and Mrs. Pease, and well known in Honolulu. It is as follows:—

"September 8.—Yesterday there was a very peculiar appearance of the sun. The sky was somewhat cloudy, but not so as to obscure the sun, which was of a silver blue colour, and not so bright but what we could look at it without any trouble. The shadow was the same as in an eclipse. There was no bright sunshine all day."

Although the journal contains no further record on the subject, nor any mention of the red glows which must have followed, it is so precise as to date and as to the phenomena observed as to be of the greatest value in continuing the history of the equatorial smoke-stream from Krakatoa beyond Honolulu and Fanning's Island, to which it had been continuously traced on its long route *via* the Seychelles, Cape Coast Castle, Trinidad, and Panama. It was observed by the barque *Southard Hurlburt* some 2000 miles east-south-east of Honolulu on September 3, at Fanning's Island on September 4, and at Honolulu in conspicuous brilliancy on the evening of the 5th. Mr. Frank Atwater, landing at Maalaea, Maui, on the morning of the 5th, observed a wonderful red glow, and marvelled much (having just arrived) if such were the sunrises in these islands. The same morning passengers on the *Zealandia* steaming southwards towards the Line were awakened by blue sunlight streaming into their berths. Mr. F. L. Clarke has supplied a report, somewhat imperfect as to date, of an obscured and coppery sun seen at the Gilbert Islands on or about September 7. This would be September 6 in our reckoning, the Gilbert Islands being west of the meridian of 180°.

Now we have the very precise date given by Miss Cathcart, of September 7 (6th) at Strong's Island, or just one day later than at Honolulu, and thirty-six hours later than the late afternoon coppery and lurid obscuration seen at Fanning's Island. Strong's Island is about 2320 miles nearly due west of Fanning's Island. This gives a rate of progress of the smoke-stream of sixty-four miles an hour. It seems proper to reckon time from Fanning's Island rather than from the Hawaiian Islands, as the latter were evidently north of the central course of the stream, and perceived its atmospheric effects half a day later than the former, although nearly on the same meridian.

It is to be specially noted also that the phenomena were characterised by the peculiarities seen at Fanning's Island, as well as at Panama, rather than those seen at Honolulu. Here the obscuration of the sun was so slight as not to have been noticed during the day, nor was any change in its colour observed, except by Mr. and Mrs. H. M. Whitney, who saw its disk green at setting on the 5th. At Strong's Island, as well as

at Fanning's Island, Panama, Trinidad, and eastward, the sun was heavily obscured, and its light changed to green at low altitudes, and blue when high up. This proves that the heavier thickness of the smoke-stream did not extend so far north as Honolulu, but was confined to a narrow belt near the equator. Fanning's Island is in lat. 2° 40' N., long. 159° W. Strong's Island is in lat. 5° N., long. 162° 30' E. The *Zealandia* was perhaps 5° N. when the blue sun was observed. Honolulu is in lat. 22° 17' N., and received only the clouds fraying off from the edge of the smoke-belt as it swept by to the southward.

The sun's rays were so greatly obscured by the density of the smoke strata in the main belt that they seem there to have failed to produce the marvellous twilight effects which were so conspicuous in Honolulu. All along the line from Seychelles to Strong's Island, we hear of lurid appearances, green sun, blue light, great obscuration, sun easily observed with the naked eye, but hardly anywhere a word about twilight effects, or red glows; while at Honolulu, under the thinner side clouds of the stream, the colour effects in the twilight were amazing.

The topic is an endless one, and I will not prolong. Many ask what is the cause of frequent revivals of the red glows, such as the very fine one of last evening, August 19. It seems merely to show an irregular distribution of the vast clouds of thin Krakatoa haze still lingering in the upper atmosphere. They drift about, giving us sometimes more, sometimes less, of their presence. It is also not unlikely that in varying hygrometric conditions the minute dust-particles become nuclei for ice crystals of varying size. This would greatly vary their reflecting power. This accords with some observations of Mr. C. J. Lyons, showing that the amount of red glow varies according to the prevalence of certain winds.

S. E. BISHOP

Hawaiian Government Survey, Honolulu, August 20

Biology v. Botany

ACCORDING to the regulations of the Cambridge Local Examinations, 1883, junior students can alone take botany, while senior students must take elementary biology instead. What has been the result? Taking the Regent's Park centre as a typical example, for it is a single school of several hundred girls, and sends up probably more than any other school in England, we find that from 1872 to 1882, inclusive, 273 senior students entered, and 191, or 70 per cent. passed in botany. In 1883, however, *none were sent up at all*. If we ask, What is the object of teaching science in schools? the answer is obviously for its educational value. Now this can only be acquired by practical study. Botany is eminently qualified for affording this use, whereas zoology is not. The lady principal of the school in question will not entertain the idea of teaching any branch of science if it cannot be taught practically, and very pertinently asks, "How can I get two to three hundred frogs, and make my girls dissect them? In the first place, the parents would not allow it." Consequently biology becomes a dead letter, and botany is discountenanced by the Syndicate for the elder girls.

On inquiring of a member of the Syndicate, I am informed that the general idea is that the juniors should study botany from this educational point of view, but seniors are of such an age that mere "object-lessons" are no longer necessary, but training in scientific thought is called for. Now, in the first place, it must be borne in mind that, from the pressure of other subjects, it is not generally, if ever, easy to teach science at all adequately in schools; and, secondly, the small amount of botany that can only possibly be taught, even to the elder pupils, is little more than practical descriptions, a certain acquaintance with the leading families of plants, and the general principles of physiology and histology. There is not the time to do more. As an examiner for the College of Preceptors for many years, and having to look over papers from schools, &c., from all parts of England, I can testify to the fact that the standard of botanical teaching is decidedly low. Of course there are exceptions, but the majority, who get less than half marks, show little more than a smattering of the subject. Instead, therefore, of insisting on elder pupils advancing to biology, my own feeling is that it would be decidedly better to encourage seniors to continue the study of botany alone, but more thoroughly. The idea of calling such botany an "object-lesson" will sound somewhat ludicrous to my fellow teachers, who know what teaching practical botany thoroughly really means!

The remedy, therefore, seems obvious. Let the seniors as before pass in botany alone, but of a higher standard if you